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Enhancing Incentive Programs with Proximal Goals and Immediate Feedback: Engineered Labor Standards and Technology Enhancements in Stocker Replenishment

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ABSTRACT

Under baseline conditions warehouse stockers (n = 23) could earn incentives if their team performed above the team quota of 18 cases stocked per hour. They were also subject to disciplinary action if they failed to regularly meet individual stocking quotas. In spite of these contingencies the stockers failed to receive bonus payments most of the months preceding the intervention. The intervention package included a task analysis in the form of engineered labor standards. Empirically derived time standards were combined to provide engineered standards for all stocking tasks. A specific time duration goal for each task was presented prior to execution of each task. Percent of standard time used to complete each task was then presented immediately upon completion of each task via a handheld Electronic Performance Monitoring (EPM) device. Thus, task goals and performance feedback immediately preceded and followed performance of each stocking task. Immediately upon onset of the intervention, employee performance increased and eventually averaged 4.46 cases stocked per hour per person, an increase of 24% over the baseline phase. Performance was maintained for the 10-week duration of the study. Team members received the maximum bonus of $300 per month for 9 consecutive months under the intervention system. Performance levels in a comparison team at another warehouse were unchanged during the entire study. Results were discussed in terms of expanding the role of Organizational Behavior Management professionals and operational and ethical issues associated with EPM technologies.

ARTICLE

INTRODUCTION

Although Organizational Behavior Management (OBM) has demonstrated the robust impact of providing immediate reinforcers to employees (Mason & Redman, 1993), many in the field have noted how it is often impractical or nearly impossible to provide real-time consequences (Dihoff, Brosvic, Epstein, & Cook, 2004; Sulzer-Azaroff & Mayer, 1991). With the advent of computer-based technologies such as Electronic Performance Monitoring (EPM) the potential of real-time feedback is beginning to be realized (Berger & Ludwig, 2006; Dihoff, Brosvic, Epstein, & Cook, 2004; Epstein, Lazarus, Calvano, Matthews, Hendel, Epstein, & Brosvic, 2002; Ludwig, 2003; Terrel, 1990). And feedback in OBM interventions is being delivered with virtually no delay between units of task performance and feedback regarding the adequacy of each unit relative to some standard. The purpose of this study was to assess the effects of using wireless data collection and feedback technology to implement an OBM intervention package as part of a larger warehouse management system (WMS) that offered productivity-based monetary incentives to employee teams.

Incentives

Monetary rewards, in the form of incentive pay, have been shown to maintain higher task performance rates than hourly pay because they deliver monetary reinforcers contingent on performance (Abernathy, Duffy, & O’Brien, 1982; Bateman & Ludwig, 2003; Honeywell-Johnson & Dickinson, 1999; Honeywell-Johnson, McGee, Culig, & Dickinson, 2002; Gaetani, Hoxeng, & Austin, 1985). Furthermore, group incentives are often more practical than individual incentives in production or manufacturing settings because they are easier to administer to a group than to each member (Keeney, 1994). In the present study, individual monetary rewards of either $200 or $300 per month per group member were made available to employees contingent on their groups’ attaining their monthly group performance goals. However, employees and their groups were rarely reaching their monthly performance goals and earning their incentives delivered contingent on goal accomplishment. The incentive system needed to be improved because the monetary rewards were not functioning as reinforcers within the system.

Incentive programs indirectly provide employees with feedback based on an area of performance important to their organization. Typically, employees are informed of their performance levels when they receive their incentive pay. When a reinforcer, in the form of incentive pay, is attained contingent upon high performance, the feedback delivered with the pay may also become a conditioned reinforcer (Sulzer-Azaroff & Mayer, 1991), if it is not already functioning in that capacity. However, feedback delivered in this manner cannot also function as a discriminative stimulus for an ongoing task performance. This is because it is rarely, if ever, delivered while the employees are performing the task or set of tasks upon which their incentive pay depends (although feedback at the end of one task can act as an analog to a discriminative stimulus for the next instance of that task).

There is empirical evidence suggesting that when individualized performance feedback is added to an individual performance incentive system, individual performance levels improve (Sama, Kopelman, & Manning, 1994). Other studies have shown that providing additional performance feedback separate from the incentive pay per se raises performance over and above levels maintained by incentive pay alone (Honeywell-Johnson &Dickinson, 1999; Honeywell-Johnson, McGee, Culig, & Dickinson, 2002). Furthermore, feedback that is delivered in the midst of the employee's tasks, proximate to their behavior, could act as a discriminative stimulus for the rest of the behavior in that task and might thereby enhance the impact of the incentive program.

Like feedback, goals are a necessary component of incentive programs because they specify the level of performance required to receive the incentive pay (Abernathy et al., 1982). Goals may also serve as discriminative stimuli because they indicate the type and quality of behaviors that are likely to be followed by reinforcers (Sulzer-Azaroff & Mayer, 1991). Incentive programs often use general goals for an entire workforce based on an average performance "quota" announced at employee meetings or publicly posted, for example, in break rooms. Goals such as these are less effective because they are not proximate to the employee behavior (Ludwig & Geller, 2001; Wilk & Redman, 1990) nor do they specify precise performance-management contingencies for each individual employee. In contrast, goals that are delivered in the midst of the employees' task and are *customized for their specific tasks* may augment incentive programs in ways that enhance effectiveness of incentive programs already in place.

Until the early 1980s, many warehouse management systems (e.g., www.ssaglobal.com) produced paper lists or tally sheets to direct activities among the workforce in the warehouse. For example, one paper list directed the fork-lift driver to take pallets from one warehouse point to another warehouse point. Another list directed an order selector to pick an order for a customer. In this context, incentive programs could not be associated with proximal goals and immediate feedback while the employee performed a task.

Soon after wireless technology became available, many warehouse management systems were re-tooled to deliver the directions for work on wireless computers. For example, order selectors now carried a handheld wireless computer that specified items to be picked for store orders, store-by-store. Antecedents such as selection instructions and pick quantities began being delivered in "real-time" as they were presented to each worker on their respective computer screen one work unit at a time. Real-time information regarding employee behavior was also fed back to the warehouse that used this information within its quality assurance inspection program and to monitor efficiency gains. This additional information management and sharing capability permitted goals and feedback to be delivered in a way that would enhance existing incentive programs. Specifically, this technology provided the logistics management, warehouse system designers, warehouse managers, and OBM professionals the wherewithal to deliver proximal goals to employees as well as immediate feedback when integrated with Engineered Standards.

Engineered Standards as Goals

Employee behaviors are often aggregated into outcome measures of productivity which are most often described as "quantity output over resource input" (Sink & Tuttle, 1989). Earlier measures of productivity in warehouse settings were often simple algorithms and quotas. The popularity of these measures was primarily a function of their simplicity given the limitations of existing measurement capabilities. The disadvantage, however, was that they were not comprehensive. For example, measuring *cases per hour* ignored the weight, size, shape of the case, and travel distance; *lines per hour* disregarded the number of cases of a product line as well as travel distance; *dollar volume per day* did not take into account the size of the order. The measure most frequently used in warehouses was *cases per hour*. Given the amount of variation among cases and travel distances, supervisors were forced to make an informed guess at the goals they wanted to assign their workers. In the absence of better productivity measurements, in many warehouses these informed guesses became de-facto goals.

One of the most effective ways to measure productivity was the *standard versus actual* comparison (Keeney, 1994). In work measurement terminology, *standard* represents the allotted time to complete the work unit whereas *actual* represents the elapsed time taken to complete the work unit. The engineered labor standard (ELS) represents a specific example. Using this method, an Industrial Engineer would subdivide a task into its elements, and each element (e.g., travel time) would be given a discrete value–an allocated number of minutes or seconds. Values were then arrived at based on the activity sampling, group sampling, and time-series studies.

According to Kanawaty (1992), *work studies* involve examination of the way an activity is being carried out, modification(s) of the operation to reduce wasteful activity, and specification of a time standard for performing the activity. *Work measurement* then allows for the time needed for a qualified worker to carry out a task (Kanawaty, 1992). Work studies and work measurement became easier and more accurate once performance recording was achieved using time-study software installed on palmtop PCs. Thus, substantially more accurate engineered standards could be and have been developed.

The merits of ELS are many. The estimated time required to complete a work task are based on direct observation and the most accurate practicable means. Taking multiple timings, such as at the beginning, middle, and end of a shift, ensures that the standard times are representative and that allowances for such factors as fatigue are taken into account. The recorded times provide an empirical foundation that can be used as the bases for positions taken by management during management-labor negotiations regarding performance standards, as opposed to the traditional practice of bargaining based on a de-facto goals that are, in effect, heuristics. Finally, engineered labor standards provide goals that can be customized for the particular work the employee is responsible for performing.

It is important for the success of any incentive scheme that workers know the goal they are working toward and any contingencies between goal accomplishment and monetary bonuses. At the host company, prior to the intervention described below, each morning an office clerk posted data regarding performance for the previous day's work on the breakroom bulletin board. Separate data were provided for each functional team (e.g., the receiving team, the stocking team, the order picking team, and the loading team). Functional team managers held a brief (not more than 5 minutes) meeting to announce their team's work-load for the day. For example, the order picking team would be told that there would be 63,000 units that needed to be picked.

Thus, goals at the host company were originally distal to the work and represented the aggregate work to be completed among all functional group members for the whole day. What the daily postings of the performance goals (i.e., distal goals) did not provide was a specific goal for each work unit (i.e., proximal goal) for each group member. The current study used empirically based engineered labor standards as goals. These goals were also customized for each work unit and delivered to each employee immediately; the employee commenced work on each work unit.

Immediate Feedback Through Technology

As previously stated, until recently, most companies used computers to track the performance of their workforce; but these computers remained in the front office where daily or weekly reports could be compiled. While feedback to workers was reliable, it was, nevertheless, delayed owing to technological limitations. When companies began putting computers on the shop floor, however, employees could view their performance during their work shift. The advent of wireless technology supported the continued migration of computer capability from the shop-floor desktop to the individual employee via either a handheld or vehicle mounted computer. Incorporation of labor management software (i.e., the ELS) into the wireless technology resulted in more valid/accurate productivity measures. Wireless technology permitted employees to receive real-time antecedents that could prompt and direct their work on a task. Hence, wireless computers could conduct real-time performance appraisals that could be converted to immediate feedback delivered to the employee during or right after completing each task. These new methods represented a significant departure from their predecessors in the warehouse, that is, paper-based performance appraisals.

Summary

The present study utilized an intervention package that included basic components of traditional OBM interventions (Johnson, Redmon,& Mawhinney, 2001) based on other studies (Agnew, 1998; Bateman & Ludwig, 2003; Jessup & Stahelski, 1999) and OBM literature describing effective contingencies of reinforcement in the field (Komaki & Minnich, 2001; Poling & Braatz, 2001). The current intervention included implementation of new, empirically based, engineered labor standards used in OBM tactics consisting of (1) proximal goals and (2) immediate performance feedback regarding degree of goal accomplishment. These intervention components added contingencies to a pre-existing performance-based incentive program. These additional contingencies were expected to increase and maintain performance levels above levels maintained by the pre-existing program.

This study examined the effects of delivering goal time and performance feedback in a “paperless” environment where the task antecedents, including both the directions to employees (where to stock the product and how many to stock) and the time-based goal (how long they should take stocking the products), were presented to the workforce on wireless handheld units. Immediate performance feedback was presented via the wireless technology and was associated with an incentive program. In the present study, the often distal relationship between goal setting and performance feedback was shifted to real-time, or what Baum (1994) calls “proximate contingencies,” in an effort to improve stocker performance.

The difference between the pre-existing contingencies and the components added to it via the intervention are depicted symbolically:

Pre-existing contingencies

S^{D}] quota announced at the beginning of shift;
R] stocking product;
Distal $S^{R]}$ feedback, possible monetary bonus delivered the
next month, or disciplinary action.

Intervention elements added (in italic) to the contingency:
Distal S^{D}] quota announced at the beginning of shift;

Proximal S^D] *goal times appeared on screen at the beginning of each work unit*;
R] stocking product;
Proximal S^R] *feedback appeared on screen at the end of each work unit*;
Distal S^R] feedback, possible monetary bonus delivered the next month, or disciplinary action.

The principles of behavior comprising our empirical theory of behavior (Hopkins, 1999) related to feedback, goal setting, and performance (Agnew, 1998; Baum, 1973; Komaki & Minnich, 2001; Poling & Braatz, 2001; Sulzer-Azaroff & Mayer, 1991) combined with empirical results (Abernathy et al., 1982; Bateman & Ludwig, 2003; Gaetani, Hoxeng, & Austin, 1985; Jessup & Stahelski, 1999; Ludwig & Geller, 2001; Wilk & Redman, 1990) resulted in our expectation that adding the temporally proximal individual goals and feedback to the pre-existing incentive pay contingencies should have the effect of increasing performance. In this case, workers should experience performance reinforcement whether they earn incentive pay or not so long as goal accomplishment per se functions as a proximal reinforcer. At the same time, workers could ultimately receive tangible monetary rewards contingent on their performance improvement that would likely function as additional reinforcement for increased performance levels and maintain those performance levels reliably and indefinitely into the future.

METHODS

Participants and Setting

This study involved an experimental and a *post hoc* comparison auto parts distribution center. The experimental center, located in the Northeastern United States, served over 100 retail chain stores, distributed most types of auto parts, including batteries, tires, engine parts, and accessories from its 400,400 square foot warehouse. This facility operated three shifts, 5½ days a week. The study was conducted in a three-level mezzanine (see Figure 1) where stockers replenished bins of product. Each level of the mezzanine had 4-5 shelving rows of product organized by family grouping and categories. Within each row, auto parts were organized into plastic bins or in vendor-specific cases that rested on a metal shelf. A bar-coded label was placed on the horizontal bar of the shelf right below the bin location to identify the bin by aisle, section within the aisle, level of the section, and location within the level.

FIGURE 1. Three-Tier Mezzanine

All the stockers at the experimental distribution center, 23 in all (21 females and 2 males) participated in the study. Their ages ranged from 18 to 35 years (mean = 23.6 years), and they had worked in the stocking department from 6 months to 8.25 years (mean = 4.75 years). They were paid $10.00 per hour plus productivity incentives (when earned) and all were employed throughout the baseline and intervention phases of this study. Stockers worked a single shift between the hours of 3:00 p.m. and 11:30 p.m. Sunday through Thursday. Within each 8-hour shift, there was a 30-minute lunch break and two 15 minute company-paid breaks. They all reported to the replenishment supervisor.

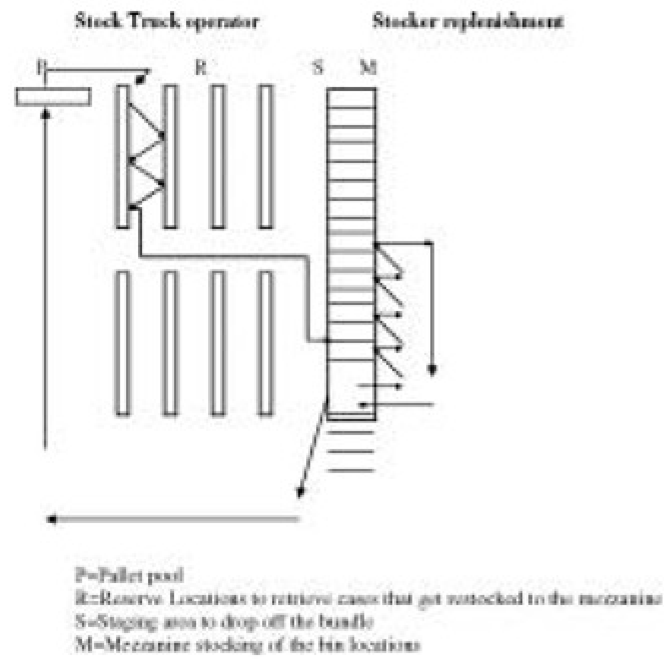
A second distribution center in the mid-western United States was used as a *post hoc* comparison group within which none of the intervention conditions were introduced to that group. The *post hoc* comparison distribution center was a 295,000 square foot warehouse distributing the same products for the same parent company as the experimental distribution center. By comparison, this warehouse center shipped to over 70 retail customers. The *post hoc* comparison center also had a three level mezzanine and was organized like the experimental center (e.g., similar product configuration and bin number coding). All 14 stockers were female. Their ages ranged from 18.2 to 32.5 years (mean = 24.9), and they had worked in the stocking department from 24 months to 6 years (mean = 2.33 years). They were also paid $10.00 per hour, worked a single shift between the hours of 3:00 p.m. and 11:30 p.m. and were on the same incentive program as the stockers in the experimental center. The stocking tasks performed in each distribution center were identical.

Task. The stocker's job was to replenish the approximately 50,000 bins located in the mezzanine in order for the picking crew to be able to satisfy the store orders later in the day. When a product was running low in a warehouse bin, a stocker was called upon to replenish the product. However, the stocker first relied on another associate to deliver product to the mezzanine. First, a driver operating a stock truck collected the needed cases of product(s) from remote bulk storage reserve areas in the warehouse. The stock-truck operator collected a "bundle" consisting of 1-12 cases containing 5-10 products (see Figure 2). The driver then dropped off the pallet at a staging location at any one of the three levels of the mezzanine.

Once the stock-truck operator completed the drop-off at the staging location, as seen in the warehouse diagram (Figure 3), the stockers received information about their next task via the stocker's handheld wireless computer. Work became available to the stockers when they

FIGURE 2. Two Bundles Ready for Stocking

FIGURE 3. Warehouse Diagram of Stocking Workflow



signed on to their respective handheld unit at the beginning of their shift or depressed the “enter” key to take on more work after the completion of the previous work unit. The screen on each stocker’s wireless computer would direct the stocker, where in the mezzanine the bundle was staged, and where these products were to be stocked. The stocker walked to the staging location shown on the handheld screen, located the bundle, and transferred the cases from the pallet to a hand-truck. The stocker received directions on the handheld computer indicating location of the bin into which each product was to be stocked and the number of cases needed to restock the bin.

When the first product was restocked, the stocker depressed the “enter” key on the handheld computer. The computer indicated where and how many cases of the second product in the bundle were to be used to restock the bin. The stocker repeated this process until all products (work units) in the bundle were used to restock bins.

From an operational standpoint, the ordering of the work units within the bundle was very important. Systematically, the Warehouse Management System (WMS) was programmed to order the work units based on the sequencing of the bins in the mezzanine. That meant the replenishment path was in one direction, one aisle at a time.

It was important to have all the bins in the mezzanine adequately replenished in time so that later in the day when store orders were picked, no store order was “shorted” (product that is absent from the filled order).

Apparatus: Handheld Wireless Computer

The handheld wireless computers were Intermec Model CK30 (L = 8.2", W = 2.8", H = 1.6") with a display window measuring 2.25" by 2.25" (see Figure 4). The stocker screen, depicted in Figure 5, could display the following information, beginning with line 3: Line 3 shows the F(rom) location, case quantity, and the number of units within the case quantity; Line 4 shows the T(o) location, case quantity, and the number of units within the case quantity; Line 6 depicts the stock keeping unit number; Line 7 displays the product description; Line 10 shows the part

FIGURE 4. Wireless Handheld Unit Used to Do Stocker Replenishment

FIGURE 5. The Original Handheld Screen

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92:ENTER TO START NEXT WORK
  LOCATION  CASE UNIT
F MR12A1       3   36
T HP0422       3   36
R
001052660 BD
 18-1901 SPRING SPA


70-1599          BC YW
 PCK    1 RPK   12
LP
 ABANDON     CASES?   (Y/N)
```

number; Line 11 identifies the pack (the number of measurable units with a bar-code inside a case) and repack (the number of retail units inside of the pack). Based on the screen depiction in Figure 5, the stocker was directed to take three cases from location HR12A1 and move them to location HP0422, cut open the three cases and deposit the 36 pieces of product from the case units into the bin container.

The WMS, handheld computers, and same stocker screen were in place for over 4 years at both the experimental and control distribution centers prior to the current study.

Productivity Measures

After studying the stocking workforce, an industrial engineer and an organizational behavior management (OBM) professional determined the elements that constituted a replenishment "work unit" for a stocker:

- travel time
- box cutting time
- stocking time

The time-study software known as the Computer-Integrated Time Study was purchased from the Clemson Consulting Clearinghouse Corporation (www.C-Four.com) and ported onto Hewlett Packard handheld computers.

A total of 70 hours of study and observation time for travel time, box cutting time, and stocking time were collected and entered into the computer's WMS tables organized by aisle labeling that corresponded to the warehouse layout.

Travel time was calculated as *seconds per foot* traveled based on the distance between the starting location and the ending location, taking into account corners and passageways. This was accomplished with a set of coordinates that mapped the entire warehouse. Box cutting time was based on product handling characteristics. For example, products requiring seven cuts, a master case and six inner cases, were assigned a cut time longer than products requiring a single cut. Each product was assigned a cut code. For example, a cut code "A" was for products requiring seven cuts. All "A" products were allocated a cut time of .8400 minutes. Cut code "D," on the other hand, was used for a product requiring a single cut and was thereby allocated a cut time of .2400 minutes.

Stocking time was based on the number of cases per product going to the bin. Time was given for the first case, and additional time for the remaining cases. For example, if there were three cases being stocked for product A, the stocking time allocated for the first case might be calibrated at .1451 minutes and an additional .1045 minutes for each additional case. Thus stocking three cases summed to .3541 minutes. Additionally, stocking time was configurable for an aisle or a range of aisles. Many warehouses stock all like products in one aisle so there would be a “hoses” aisle, a “rotors” aisle, and a “filters” aisle, to name a few. Stocking times could be set to one value for the “hoses” aisle, another value for the “rotors” aisle, and yet another for the “filters” aisle. Depending on the product being stocked, the stocking time would be reflective of the aisle being stocked.

Based on the individual element times, the standard time was calculated as:

Standard Time = Travel Time + Box Cutting Time + Stocking Time

The engineered standard time was calculated by the WMS computer for each unique work unit a stocker was asked to complete. By way of example, a standard time of 1.99 minutes for a work unit might comprise .4500 minutes travel time + .5400 minutes box cutting time + 1.0000 minutes of stocking time.

There was an underlying assumption that identical travel times (seconds per feet), box cutting times and stocking times would be comparable throughout the geographically disperse network of distribution centers. It was assumed that a normal walking pace, a normal cutting pace, and a normal stocking pace should be the same for associates working at any distribution center.

Dependent Variable

The engineered standard time was then compared with the actual time it took the stocker to get the one work-unit completed. Actual time was measured by time-stamps provided within the WMS software. The performance percentage was calculated as the engineered standard time (travel time + box cutting time + stocking time) versus the actual time it took to complete the work unit:

Performance Percent = Standard Time/Actual Time

The dependent variable was the “percent to standard” ratio calculated as Performance Percent = Standard Time/Actual Time. With Engineered Labor Standards, the Performance Percent was 100% if the stocker finished the assigned task in the same time as the standard required. If the Performance Percent was above 100% then the stocker finished the assigned task in less time than the standard required. For example, if the standard time was calculated to be 10 minutes and the actual work was done in 8 minutes, the performance percentage would show 125%. Likewise, if the Performance Percent was below 100% then the stocker finished the assigned task in more time than the standard required. For example, if the standard time was calculated to be 10 minutes and the actual work was done in 12 minutes, the performance percentage would show 83.3%.

The Performance Percent variable was then monitored on an electronic performance monitoring (EPM) screen (see Figure 6) viewable on a PC and an associated on-demand real-time report used by the supervisors to monitor activity. The replenishment supervisor accessed this screen periodically during the shift to monitor lunches, breaks, and

FIGURE 6. Electronic Performance Monitoring Screen of Associate Performance Showing Active Associates, Their Assignment, Performance Percent, Standard Time, Starting Time and Projected Ending Time Providing an Easy Method of Detecting Associates Who Are Running Below Standard Performance

PERFORMANCE INQUIRY DATE: 08/15/04
JOBCODE:

ASSOC NBR	ASSOC NAME	ASSIGN NBR	PERF PCT	STD TIME	START TIME	END TIME
0004	GOOMAS	16842502	104	13.00	10:47	11:00
0024	MORRISON	20144518	98	14.87	11:24	11:39
0033	LUDWIG	16713903	90	16.77	11:08	11:25
0052	WILLIAMS	69760204	84	17.72	11.01	11:19

employee performance. These daily EPM reports were then compiled by the company into monthly Performance Reports which were subsequently used by the research team to compile the dependent variable information for both the experimental and comparison distribution center.

Existing Incentive Program

Group bonuses were based on exceeding an announced and published quota posted in the break-room. For the stocking team it was an average of 18 cases per hour minimum, an average of 18.9 cases per hour for the $200 bonus and an average of 19.26 cases per hour for the $300 bonus. Other quotas for other functional teams, such as the receiving team, loading team, tire team, and order picking team, were also listed. If the average performance of the stocking team exceeded the 18 cases per hour minimum quota by 5% (an average of 18.9 cases per hour) during a given month, a bonus of $200 was added to each stocker’s paycheck on the last paycheck of the following month. If the team exceeded the 18 cases per hour minimum quota by 7% (an average of 19.26 cases per hour) during a given month, a bonus of $300 was added to each stocker's paycheck on the last paycheck of the following month. As a team-performance-based bonus program, however, members who individually exceeded the quota by 5 or 7%did not receive the bonus if the entire team average failed to exceed the quota at either of the two specified levels. As average team performance varied from month to month, so did bonus pay. It was noteworthy that the average team's performance failed to produce a bonus on 4 of the last 9 baseline months.

When an individual failed to achieve the published quotas over a 1-week period, disciplinary measures began with a verbal warning. A second failure within 3 months following the verbal warning resulted in a written warning with the employee placed on probation for 3 months from the time of the second infraction. A third failure within the probationary period resulted in immediate dismissal. All disciplinary measures were officially documented by the immediate supervisor, co-signed by the operations manager, with a copy of the report sent to the regional human resource office, and a copy placed in the employee's file. In the case of the stocking workforce, there were no disciplinary actions taken during the course of this study for either the experimental distribution center or the *post hoc* comparison distribution center.

Research Design

The current study used an ABC design with a 5-week baseline, a 2-week period where goal and performance feedback were depicted on the handheld computers, and a 10-week period where the existing incentive program was linked to performance feedback based on the engineered labor standards (see Table 1). A *post hoc* comparison distribution center with no goal and performance feedback on the handheld computers was used for comparison.

Goals and Feedback Based on Performance Percentages

After the baseline period the handheld computer screen was enhanced to depict GOAL (standard time of the current of work unit to be performed) and PERF% feedback (standard time divided by actual time of the immediately previous completed work unit). Each time the stocker

TABLE 1. Preparation and Implementation of the Intervention Components

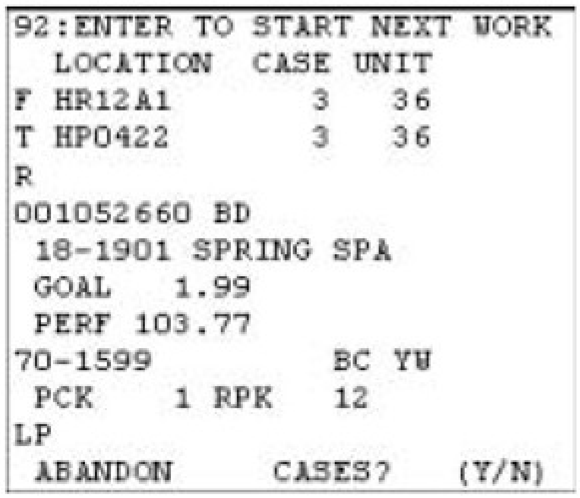
Phase	Components
A (5 weeks)	*x- and y-coordinate/warehouse points added to computer tables
	*case timings added to computer tables
	*cut codes added to computer tables
	*second per feet travel times added to computer tables
	*daily audits
B (2 weeks)	*goal and performance percent fields added to screens
	*task clarification meeting with Industrial Engineer
	*daily audits
C (10 weeks)	*initiated with CSS meeting with operations manager
	*adaptation of engineered labor standards
	*daily audits

depressed the “enter” key on the handheld unit to obtain the next work unit, the screen showed the next product in the bundle along with the new goal for the next work unit and the performance percentage from the previously completed work unit (see Figure 7).

For example, a GOAL time of 1.99 minutes represented the engineered time of the current work unit and a PERF of 103.77 represented the performance percentage of the previous work unit. This information informed the stocker that he or she was working “on-time.” If, however, the PERF indicator was showing a performance percent of 82%, then the stocker received feedback that he or she was behind the goal and needed to decrease the time to complete the work. Falling behind or getting ahead did not affect subsequent GOAL times because each work unit’s calculation was an independent event.

At the outset of the intervention the stockers saw the new screen showing GOAL and PERF%. The 23 stockers were assembled for a task clarification meeting conducted by the Industrial Engineer. The meeting involved a description of the new algorithm and its components, a demonstration of the new screen, and a question-and-answer period. The stockers were told there would be “a couple weeks” before the

FIGURE 7. The Handheld Screen Enhanced to Show GOAL Time and PERF Percent on the Eighth and Ninth Line of the Screen, Respectively



existing incentive program would incorporate the engineered standards and the new information on the screen. They were told, for the time being, the only change was that the GOAL and PERF% would be displayed on the handheld to get them used to viewing the new screen. The 2-week period of viewing the goal and performance feedback permitted assessment of any performance changes owing to task clarification or the introduction of the new screen. Otherwise the quotas and bonus structure remained the same.

Adaptation of the Incentive Program

Following the 2-week period when employees were asked to become acquainted with the GOAL and PERF% information, the operations manager called a meeting with the stocking associates at the start of the shift and announced that the adaptation of their incentive program based on the new engineered standards and performance feedback would begin and described how it would work.

Arrays of contingency-specifying statements were made in the presence of the employees during this meeting (Huber, 1986; Johnson, Mawhinney, & Redmon, 2001). The operations manager met with the stocking crew at the beginning of the shift and clearly stated that “engineered standards and performance monitoring were now in effect” and that each stocker was “expected to be at 100% performance.” Furthermore, “there would be a one-week grace period after which time-related disciplinary actions would be in effect” and that “making share [bonus] was dependent upon achieving the previously established quotas for the team." The operations manager reviewed the quotas and the bonus structure and specifically described the two discrete levels of $200 per person for the month for stocking an average of 18.9 cases per hour and $300 per person for the month for stocking an average of 19.25. The operations manager explained that "on the new standard, whether you have a large bundle or a small bundle, many cuts or several cuts, you'll be given credit for exactly the work you are doing, so your percentage will reflect your effort. You will be given time based on the distance you have to travel, the number of cartons, and the number of cuts. If you average 100% as a team, the 18-case quota will be exceeded and everybody will get a bonus."

As part of their daily warehouse meetings, the operations manager and replenishment manager printed the on-demand labor report in order to insure members of the stocker replenishment workforce individually and as a team maintained the goal of 100%.

RESULTS

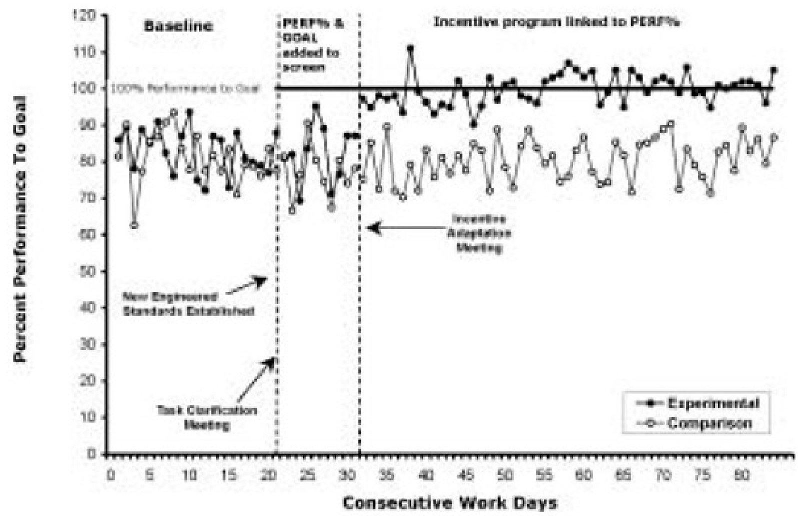
The stocker performance percentage using engineered labor standards for the Experimental Distribution Center and the Comparison Distribution Center across the three experimental phases are depicted in Figure 8. During the baseline phase (day 1 through 23) the average stocker performance at the experimental distribution center was 82.9% of the engineered labor standard, with a range from 72.2 to 93.6% (*SD* = 6.08). This corresponded to an average of 18.32 cases stocked per hour per person. This was consistent with the 18-case quota that had been in force for almost 12 months.

During the first intervention phase (24-30 days) when the wireless handheld computers provided GOAL and PERF%, the average stocker performance at the experimental distribution center was 82.3% of the engineered labor standard, with a range from 69.3 to 95.2% (*SD* = .57). This corresponded to an average of 18.43 cases stocked per hour per person, also consistent with the 18-case quota.

During the second intervention phase (31-84 days) bonus pay contingencies were in effect based on PERF% configured to the ELS, the average stocker performance of the 23 associates at the experimental distribution center was 99.8% of the engineered labor standard with a range from 92 to 111% (*SD* = 4.09). The performance percentage increased almost to 100% immediately on the first day the engineered labor standards were announced.

As Table 2 shows, the individual performance of the 23 stockers at the experimental distribution center one day prior to the operations

FIGURE 8. Stocker Percentage Performance to Goal Using Engineered Labor Standards for the Experimental Distribution Center and the Comparison Distribution Center Across the Three Experimental Phases



Note: Filled circles represent the experimental distribution center and filled triangles depict the comparison distribution center.

TABLE 2. Cases Put-Away Per Hour for 23 Participants (P#) and Averages (Avg.) the Day Before and the Day of the CSS Intervention Meeting

Participant	Day Before	Day of CSS Intervention
1	17.20	22.20
2	20.30	23.20
3	17.80	23.50
4	20.30	22.20
5	18.90	22.30
6	23.10	24.70
7	22.10	24.40
8	17.70	19.40
9	16.20	24.70
10	16.30	25.90
11	20.50	19.40
12	22.10	22.20
13	19.40	22.60
14	12.60	23.00
15	19.10	25.80
16	19.50	20.70
17	14.90	20.60
18	21.50	24.20
19	19.40	21.70
20	12.60	22.80
21	19.10	24.30
22	19.50	24.10
23	13.70	22.60
Avg.	18.43	22.89

manager's contingency specifying statements meeting compared with the same individual's performances on the day of the meeting, the increase corresponded to an average of 22.89 cases stocked per hour per person, an increase of an additional 4.46 cases per hour per person. The *t*-test result for related samples was 6.84, which was statistically significant (df = 22, $p < .001$).

The stocker percentage performance within the *post hoc* comparison distribution center, as depicted in Figure 8, had all warehouse points mapped out but had not implemented engineered labor standards and showed neither the GOAL nor the PERF% on the handhelds. The average stocker performance was 80.18% of the engineered labor standard, with a range from 62.6 to 93.5% (*SD* = 6.25) spanning 84 work days. This corresponded to an average of 18.02 cases stocked per hour per person, also consistent with the 18-case quota.

Costs and Benefits

The cost of the intervention was the professional time of both the Engineer and OBM consultant (which included software development) equated to about 240 person-hours (the equivalent of 6 weeks of pay, calculated at a total of $12,000) spanning 6 months (3 months baseline which comprised of time-studies and programming time).

It is noteworthy that the workforce benefited by making incentive pay for 9 consecutive months after the implementation of the intervention. Furthermore, notes from weekly warehouse meetings show that prior to the intervention, there were occasions where the stocking team received no incentive pay for a given month. There were no hardware costs, as the RF units were already part of the warehouse activity. Over the 9 months following the adaptation of the incentive program, the company paid out additional bonuses in excess of $62,000 for 9 consecutive months of bonus money at the $300 level compared to the 9 months prior to the intervention where the stocker team only earned five bonuses, valued at $25,300, with only one occurrence at the $300 level (4 months at $200 for 23 associates for $18,400 and 1 month at $300 for 23 associates for $6,900). Annualized, it can be estimated that this program would cost the company an additional $36,800 a year in employee bonuses.

The benefits of the new labor standards, feedback, and incentives were measured in the reduction of labor hours needed to complete the work and associated cost reductions. During baseline, the average cases stocked per hour was 18.43 per stocker. At the end of the intervention, stockers were consistently stocking 22.89 cases per hour. This is an increase of 4.46 cases selected per hour per stocker. This equates to an increase of 820 cases per 8-hour work day across all 23 stockers. Therefore, if the company asks their stockers to stock an average of 18 cases per hour, we can estimate that the company saved 45-stocker hours a day because of the increased productivity seen during the intervention. Stockers were paid an average of $10.00 per hour for approximately 18 cases per hour. Thus a good estimate of savings per day in stocker time would be $450 per day. Therefore, for the 10 week incentive period in this study, comprised of 53 work days, it is estimated that for the period of the study, the warehouse saved $23,850 in stocker labor costs. Annualized, the savings were estimated to be nearly $117,000, calculated as $450 per day, 5 days a week, for 52 weeks. Given the estimated savings, the stocking team size could be reduced if the pre-intervention performance levels satisfied the daily demand for restocking.
The reduction in workforce could be accomplished either through transferring some stockers to other areas of the warehouse when staffing levels in those areas fell below staffing needs, or through attrition within the stocking group.

Additionally, hours of overtime, paid at a rate of one and a half times normal wages, were reduced from 108 hours during the 9-month period before the intervention to only 10 hours during the 9 months after implementation of the intervention. Thus, overtime was reduced from, a baseline cost of $1,620 (108 hours * $15.00), to a reduced cost of $150 (10 hours * $15.00) with the intervention. This represented an additional savings of $1,470 ($1,620-$150) during those 9 months for an annualized savings of $1,960.

Annualized, these reductions in labor costs and paid overtime would result in benefits of over $118,000. In conclusion, the benefits of the intervention program and its continued use more than covered its costs, estimated at $12,000 for the one-time cost of the Industrial Engineer and the OBM professional's time and an additional recurring cost of $40,000 in added bonuses (culminating in approximately $80,000 a year in incentive system bonuses). And, under the assumption that the stockers' performance levels would be maintained, perhaps for years, these saving would accumulate to even more practically significant levels through the years.

The system is still in effect, in large part, owing to the satisfaction of the workforce and management. One of the comments stockers have repeatedly stated is "It helps keep me focused." Another stocker commented that "I make more money with the bonus than I would with a pay raise." That is because a $0.50 raise per hour is only $80.00 more per month as compared with the $300.00 more per month as a result of earning the maximum monthly bonus.

DISCUSSION

This study showed how an OBM intervention package could be accomplished with computer technology and labor-management practices to increase productivity. The OBM tactics of proximal goals, immediate performance feedback, and contingent rewards were used in conjunction with handheld wireless technology to increase productivity in a warehouse setting.

As each work unit was presented to the stocking associate, he or she was given the goal-time for the current work unit as well as performance feedback on the work unit just completed. As a result each stocker maintained 100% productivity via combined goal-setting and feedback throughout the day and received a monetary bonus at the end of the month.

The intervention described and assessed in the present study was initiated by an OBM professional when confronted an organizational performance problem. The problem took the form of a group-based monetary performance incentive system that did not consistently produce the level of performance it was supposed to support. A theoretical analysis of the problem suggested that while the group-based monetary incentives seemed large enough ($200 and $300 per group member) to support high consistent performances, the month-long delay between performances achieved and receipt of incentive payments may have reduced the salience of these consequences. The problem solution selected for implementation was based on OBM theories regarding temporal proximity among antecedent goal specifications, participants' performance-related responses to the goal specifications, and feedback regarding degree to which each task goal was achieved from moment-to-moment during every work day. Temporal proximity of goals and feedback regarding their accomplishment was achieved task-by-task and virtually moment-by-moment. The expectation that the wireless handheld technology and ELS used to provide goals and immediate feedback would result in reinforcement of higher performance rates among stocker-participants was based, in part, on the assumption that these elements of the intervention were highly likely to increase the salience of the group-based monetary incentives. Higher performance rates were achieved by increasing salience of minute-by-minute proximate (Baum, 1994). A: BÆC goal and performance feedback contingencies in the context of a monetary incentive contingency that was in place before, during, and after the intervention.

Previously during baseline, the bonus was based on a three-term contingency that may be described as:

Distal SD) quota announced at the beginning of shift;
R) stocking product;
Distal SR) feedback and possible monetary bonus delivered the next month.

In essence the intervention enacted the following enhancement (in italic) to the baseline contingencies:

Distal S^D) quota announced at the beginning of shift;
Proximal S^D) GOAL appearing on screen at the beginning of each work unit;
R) stocking product;
Proximal S^R) *PERF% appearing on screen at the end of each work unit*;
Distal S^R) feedback and possible monetary bonus delivered the next month.

A key to the success of the OBM package was the delivery of the contingency-specifying statements (Huber, 1986; Johnson, Mawhinney, & Redmon, 2001) orally during group meetings wherein clarifying questions could be fielded. The Industrial Engineer's explanation of the program was thought to be crucial to the stockers' understanding of the GOAL and PERF% information, and the operations manager's explanation of the adapted incentive program to the ELS was thought to be crucial to the stocker's understanding of the minute-to-minute salience of the incentive contingency.

Performance of the stockers increased immediately following the announcement of the engineered labor standard and remained at near

100% for the duration of the 10-week intervention phase (C). The major findings of the present study are consistent with previous OBMr esearch (Bateman & Ludwig, 2003; Nicol & Hantula, 2001; Pritchard, Jones, Roth, Stuebing, & Ekeberg, 1988; Tjosvold, 1986) in that they add to the body of empirical evidence supporting the fact that incentive programs, when properly supported with feedback, can increase desired performance. In addition, however, this study demonstrated that (1) computer technology can be used to deliver proximate goals and immediate feedback and (2) that these proximate goals and immediate feedback can be added to an existing incentive contingency to produce practically significant productivity gains.

However, caution is advised because the ABC design did not include reversals. While a reversal of treatment effects would have provided stronger evidence regarding the causal role of the intervention in the performance improvements observed, reversal designs are not well tolerated by owners and managers. The resistance to reversal of positive effects noted by Gaetani, Hoxeng, and Austin (1985) was encountered here. In a field setting such as this one, gains in realism may well offset concerns with internal validity (Komaki & Goltz, 2001). Nevertheless, we attempted to offset this limitation by using data from a *post hoc* comparison distribution center where productivity remained unchanged during the same time frame as the experimental intervention. This suggested that performance increases might have been associated with the intervention package rather than some uncontrolled variable or confound. In the future, an even more closely matched comparison group could be used or, if possible, workers could be randomly assigned as a control group from the same facility.

Another caveat concerns the potential effects of the disciplinary contingencies that were in place throughout the baseline and intervention phases of the study. For example, the new system, in addition to providing stockers with precise task goal specifications, provided the same information to supervisors, thus making it likely that supervisors could more efficiently engage in surveillance of stockers. If stockers noticed the increased ease with which supervisors and management might track their performances, the disciplinary contingencies carried over from the baseline contingencies into the intervention may also have become more salient. The disciplinary contingencies were, more likely than not, avoidance contingencies that would likely be experienced as aversive but might, nevertheless, have contributed to increased performance levels upon implementation of the intervention package.

Unfortunately, about the only way to test for effects of this sort of contingency would be to remove the group goal and individual incentive payments based on group goal achievements. Another way to address the issue would be to collect job satisfaction data (Mawhinney, 1989) prior to intervention and after the intervention had been in place for some time. Another way in which aversive effects of interventions may be manifest among participants is increased absences. For example, Wilk and Redmon (1990) notice a spike in the recorded hours of absence that occurred during the second of 26 intervention observations following introduction of daily-adjusted goal-setting among participants in a university admissions office. However, that spike was followed by a reduction in both the level and variation in absences for the remaining 24 biweekly observations. In the future, therefore, it would make sense to collect job satisfaction data and/or track hours of absence from work or whatever measure archived by host organizations as a means of assessing the degree to which intervention contingencies constitute improvements in the "quality of work life" on the job in addition to improvements in organizational efficiency.

It should be mentioned that monetary rewards before, during, and after the intervention were still tied to *cases per hour* (i.e., 18 cases per hour). An alternative for future studies (and future real-world applications) would be to tie the monetary rewards to the precisely measured 5% above the ELS for the month would merit a $200 bonus; and 7% above the ELS would merit a $300 bonus. The benefit to tying monetary rewards to the ELS is that it takes into consideration the travel time, cutting time, and stocking time. In short, it is a more valid measure of performance than cases per hour.

Using the engineered labor standard approach accentuated the fact that benchmarking, using *cases per hour*, 18 cases per hour in this case, was not as "productive" as had been announced, published, and posted in the break room. It is reasonable to argue that the quota should be revised to reflect performance in terms of the ELS. Once the work unit was engineered to incorporate travel time, cutting time, and stocking time in performance standards, and immediately following the announcement of the engineered labor standard and the OBM package (goal time, performance percent, and monetary rewards), the stocking associates began stocking an additional 4.46 cases per hour per person. It is imperative, however, that the engineered labor standard be kept up to date, requiring that the cut codes and stocking times for new products be maintained at all times. If the standard is *not kept current* it will have a short shelf life, its validity will likely fall, and, more likely than not, benefits of the initial investment will eventually decline. In a worse case scenario the required time to complete tasks might raise while the specified time remained constant. This would require stockers to work at higher speeds simply to "stay even" relative to quota achievement and also make it likely they would eventually fail to earn bonuses in spite of working harder than ever. This would be equivalent to what in the past was called incentive rate cutting.

Behaviorally, we suspect that when a work unit was completed, say, at 90% performance, the stocker would walk a little faster and stock a little faster to make up the deficit for the next bundle or two. This has important implications regarding occupational safety. This study took into account fatigue by performing observations and time studies early in the shift, during the middle of the shift, and at the end of the shift; otherwise if we had observed the associates only at the beginning of the shift where everyone was generally alert and attentive, and we had used only those timings, it would have been possible for the number of accidents to increase as tired employees hurried to get their work on time as the end of the shift drew closer in time.

The host company performed periodic audits verifying the accuracy of the standard, including fatigue, in its calculations. Overall, the company recorded no accidents during the course of this study and continues to have one of the lowest accident rates in the industry. It is important that the engineered standard represent a “normal” workflow which can only be achieved by continual study and observation.

In future studies researchers should review safety records to determine whether accident rates are associated with workers attempting to make up for lower performance rates. Additionally, future studies should attempt to confirm this possible connection between worker behavior and accident rates by direct observations of work-related behavior among individual workers, including workers in other functional areas of the warehouse.

Although this study was able to verify the immediate benefits of linking OBM methods (proximate goals and immediate feedback) with performance technology (handheld computers), there are several practical challenges maintaining effectiveness of such performance management systems. Because this industry experiences 40-60% turnover annually in the workforce, practical ways of promoting job satisfaction are important (Mawhinney, 1984). The host company has implemented initiatives for retaining the workforce by promoting job rotation. From the standpoint of variety, feedback, reducing boredom, and stress, job rotation has the added benefit of improving the workforce skills and improving the flexible use of the workers (Beehr, Jex, & Ghosh, 2001).
It is interesting to note that there was no turnover in the stocking workforce during the period of examination because, in general, stocking small parts off of a hand-truck is considered a far easier task than, say, picking tires, batteries, or bulky items, where much of the turnover seems to occur.

The OBM deliverable, then, is not merely placing the goal or the feedback on a wireless computer, or the intervention, or the technology. The OBM deliverable must be part and parcel of sound operational principles. Otherwise you end up applying labor standards to bad practices and the engineered labor standard and the OBM component may be eventually misused, or worse, discarded.

When the WMS is integrated with a labor component that is tied to incentives, rather than just a *warehouse management system*, one that enables the warehouse to respond to order fulfillment and inventory control, the result is a *managed warehouse system*–one that supports warehouse information, business processes, warehouse activity, and performance monitoring.

As more and more distribution centers go “paperless” the often distal relationship between goal-setting and performance feedback can be shifted to real-time, and as seen in this study, the impact on stocker performance may be immediate and sustained. We see that various functions of the warehouse, such as order selecting (Bateman & Ludwig, 2003) and now stocker replenishment, can be better managed by applying sound Organizational Behavior Management principles, whether it has to do with increasing accuracy, as reported by Bateman and Ludwig (2003), or increased productivity reported here. The benefit of doing the job right means the ability to manage proper staffing levels, improving productivity by providing a full workload for every associate and the reduction of overtime. When performance is tied to bonuses, share, and other incentives, companies often achieve better employee retention, a reduction of overtime, higher employee satisfaction, higher employee motivation, fewer accidents, fewer errors, and better quality of work (Richards, 1986).

Finally, the expanding role of the OBM professional in creating solutions and implementing effective interventions and feedback systems in warehouse settings should continue to be documented. Studies such as this demonstrate that with the help of an OBM professional, the implementation of expensive technologies and complex labor practices (e.g., incentive programs that are individualized or team-based) can be better optimized to change employee behavior for the mutual benefit of the company and the employee.

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